



**2023 Fall Conference at Ashore Resort & Beach Club  
Ocean City, Maryland**

**Repair Process for the Thomas J. Hatem Memorial Bridge  
over the Susquehanna, Part II**

David S Lynch, PE (H&H) and Nafiz Alqasem, PE (MDTA)

September 29, 2023

# BIOGRAPHIES

**David S. Lynch** is a Licensed Professional Engineer in H&H's Annapolis, Maryland office. He has a total of 25 years in the industry and is an integral part of maintaining Maryland's infrastructure since 2013. His current focus is inspecting, evaluating, and rehabilitating bridges and tunnels. His technical expertise also includes feasibility analysis of large-scale and complex capital improvements and the design of various transportation facilities including public spaces.

**Nafiz Alqasem** is a Licensed professional Engineer. He has been working for MDOT for a total of 36 years. He is currently the Deputy Director of Project Development in the Office of Engineering and Construction at the Maryland Transportation Authority where he has been for the last 23 years. Prior to that, he worked in the Office of Bridge Development at Maryland State Highway Administration (SHA) for 13 years. His time at SHA was split between the office of Bridge Design Quality Assurance and the Office of Bridge Inspection and Remedial Engineering.

# ABSTRACT

- H&H, LLC in conjunction with the Maryland Transportation Authority
- The Hatem Bridge is a late 1930's era signature steel bridge over the Susquehanna River that provides a lifeline between Harford and Cecil Counties. This presentation will discuss the challenges of the design of the steel repairs to be performed as part of Contract HB-3001, Cleaning and Painting and Miscellaneous Structural Repairs of US 40 Bridge over the Susquehanna River. The detailing of steel members was characteristic for the period and the nooks and crannies inherent in built-up members have proven problematic. Further complicating the design are multiple structural systems along the full length of the Hatem Bridge, each with a range of issues.
- Minimizing impacts on the cleaning and painting operations is paramount. The design had to minimize temporary works; keep repairs achievable by crews that may not be specialized; and limit the size and weight of steel plating. Conservative assumptions and engineering judgment were blended to design repairs for identified components and connections with significant section losses and as-built drawings and inspection reports were used to inform the design. Variations in geometry after 80 years of settling and modifications prompted reevaluation of the repairs in many locations. It was assumed that additional defects will be identified during the cleaning and painting process. The variety of repair types included in the Contract provides a level of adaptability for unforeseen defects that can be addressed.



The presentation will deliver 1.0 PDH



# THOMAS J. HATEM BRIDGE - Outline

- Magnitude of the bridge
- Problematic Details
- It's a Cleaning and Painting Contract
- As-Built VS Reality
- Design Examples

# Magnitude of Bridge

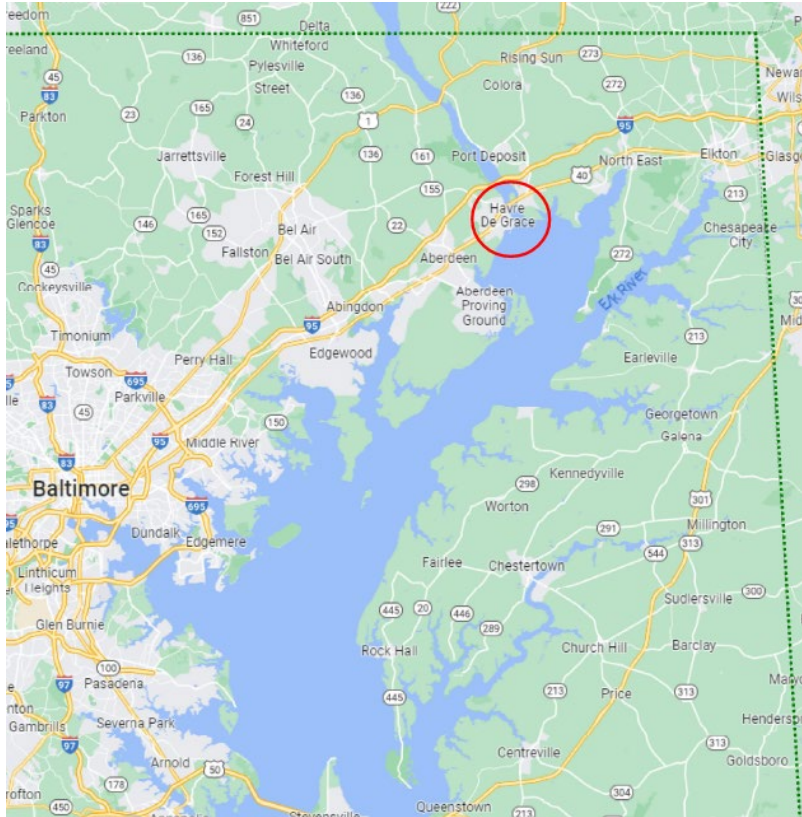
## THOMAS J. HATEM BRIDGE Memorial Bridge Description

### Bridge Identification Number (BIN) H-Z040001

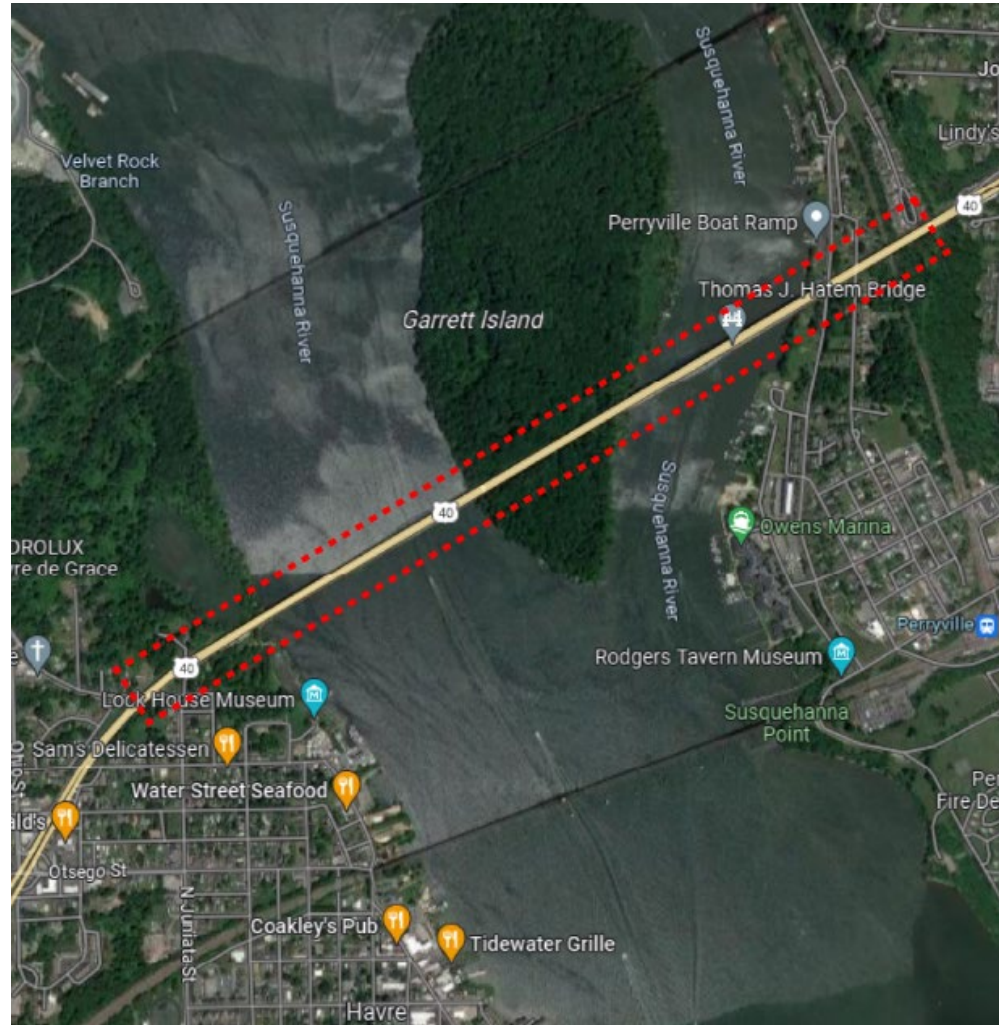
- Built in 1939 and underwent major rehabilitations in 1988, 2011, and 2017
- Carries four lanes of US-40 eastbound and westbound (two each way) over the Susquehanna River from Havre de Grace (west) to Perryville (east)
- Crosses multiple roadways as well as both CSX and Norfolk Southern railroads
- 56 spans approximately 7,749 feet long and approximately 55 feet wide
- Comprised of 11 total subunits with 5 distinct structural systems

# Magnitude of Bridge

## Bridge Location



*Havre de Grace  
to the West*



*Perryville  
to the East*

# Magnitude of Bridge

Beam Spans (2 Subunits): S0A – S01 and S52 - S54



S0A – S01  
Shown

# Magnitude of Bridge

## Girder Spans (2 Subunits): S02 – S09 & S46 – S51



S02 – S09  
Shown



# Magnitude of Bridge

Wichert Girders (3 Subunits): S10 – S15, S22 – S35, & S42 – S45



S10 – S15  
Shown

# Magnitude of Bridge

(Wichert) Deck Trusses (2 Subunits): S16 – S18 and S36 – S38



S16 – S18  
Shown

# Magnitude of Bridge (Wichert) Through Trusses (2 Subunits): S19 – S21 and S36 – S38



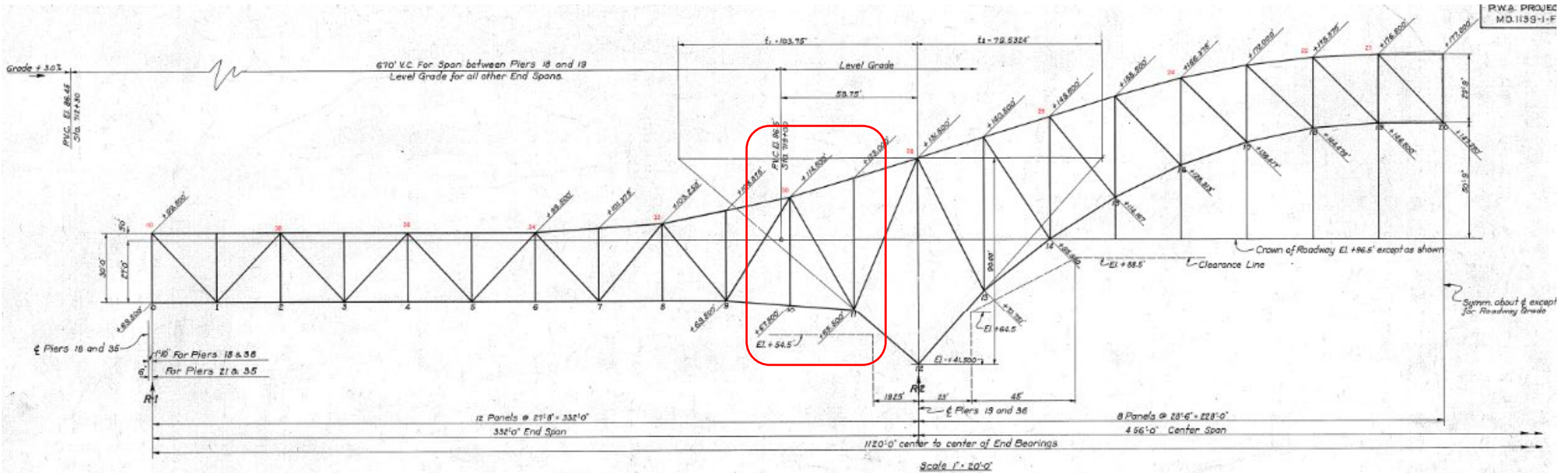
S36 – S38  
Shown

# Magnitude of Bridge Total Number of Repairs

Milestone	Start	Initial Scoping	30%	60%	75%	90%	100%	Add. 2
No. of Repairs	2,543	680	245	238	241	240	240	<b>277</b>
No. of Repair Types	Not Applicable		66	58	41	39	40	<b>40</b>

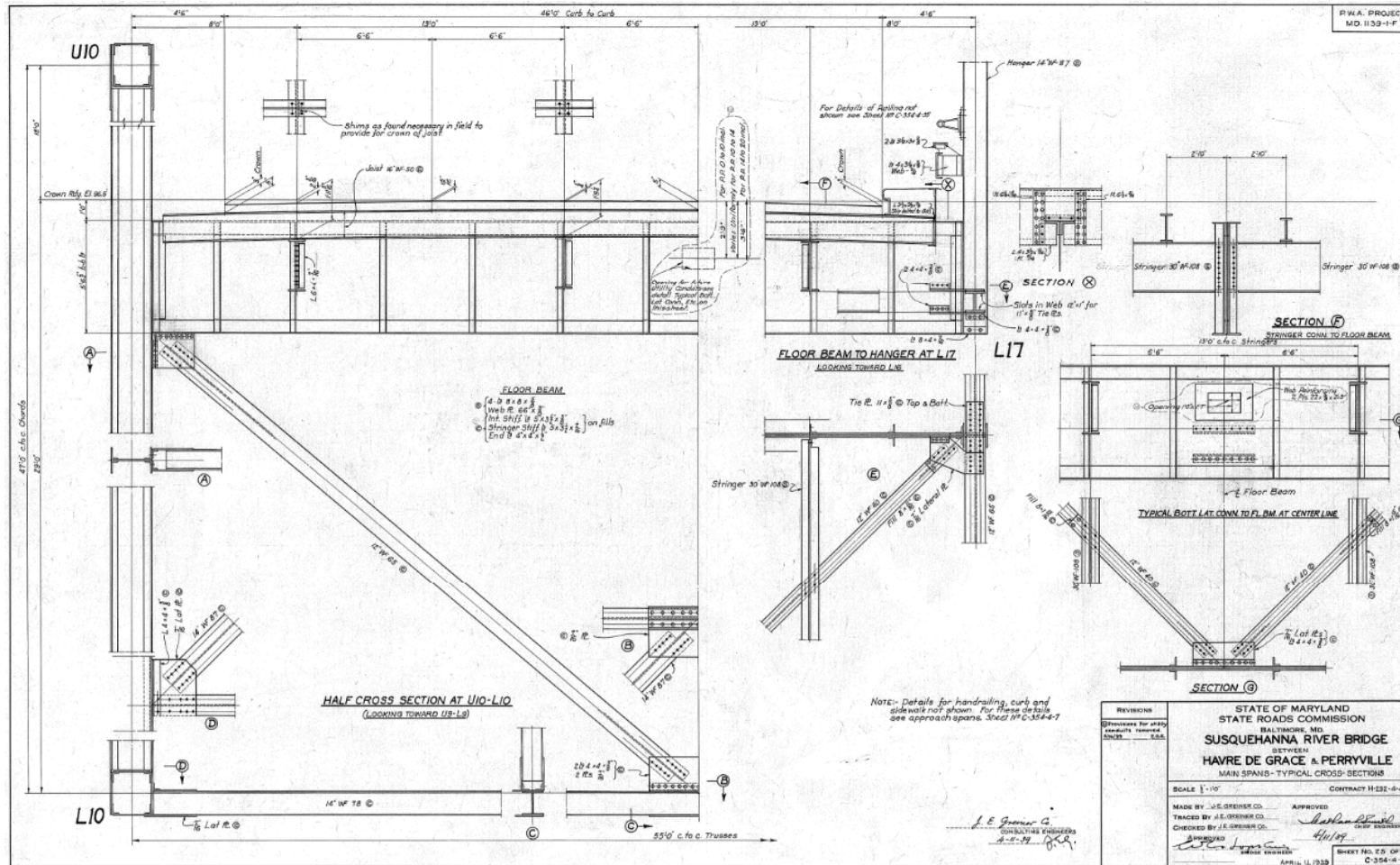
- Repairs from 2022 – 2023 Inspection incorporated in Addendum No. 2
  - Number of repair Types unchanged

# Problematic Details – Built-Up Members, 1000' View



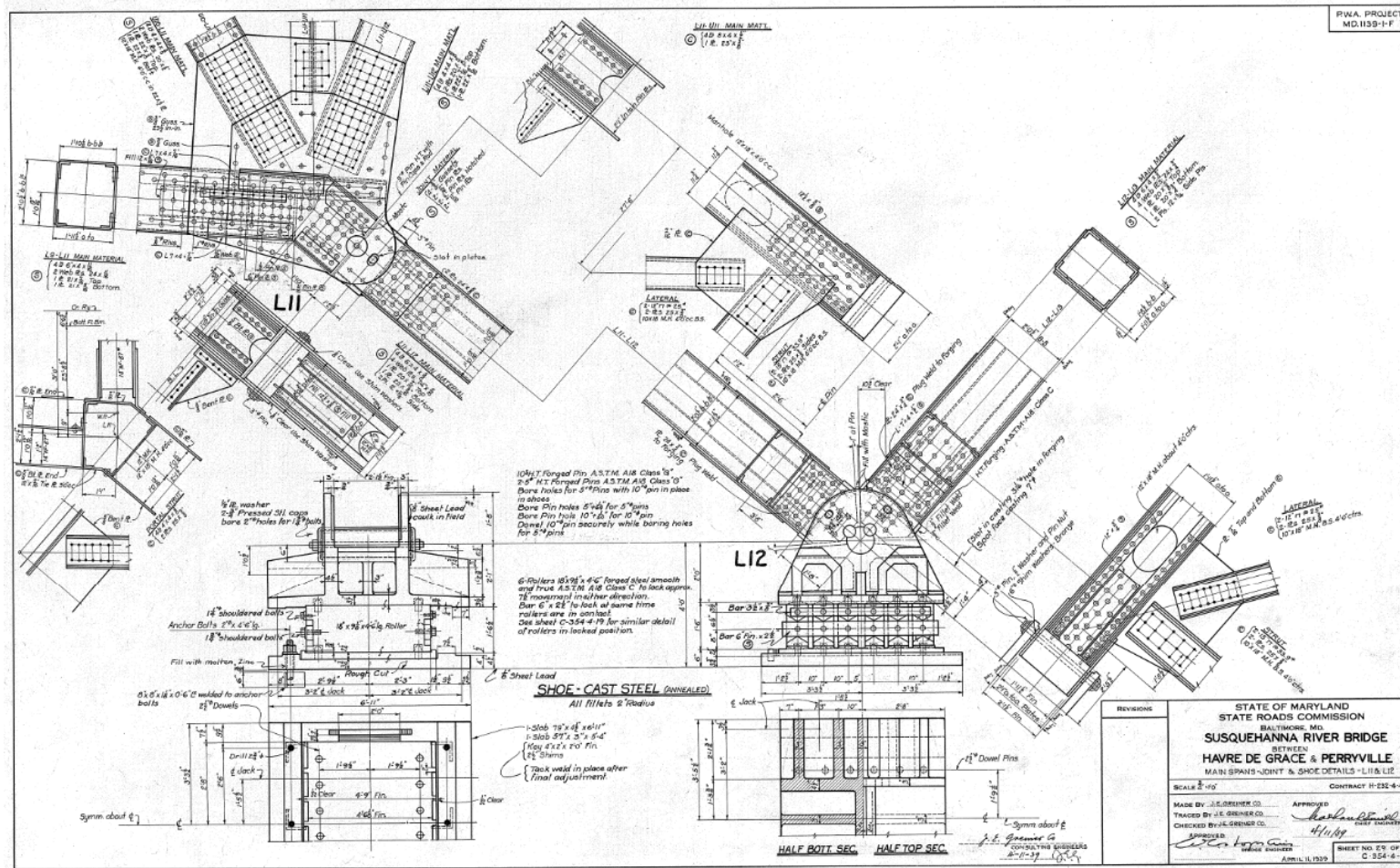
- Statically Determinate Designs
- EFFICIENT use of materials

# Problematic Details – Built-Up Members, 100' view



- Details start to come into focus at this level.
- Multiple basic members, connections, and overall approach can be seen
- Efficient use of materials still evident

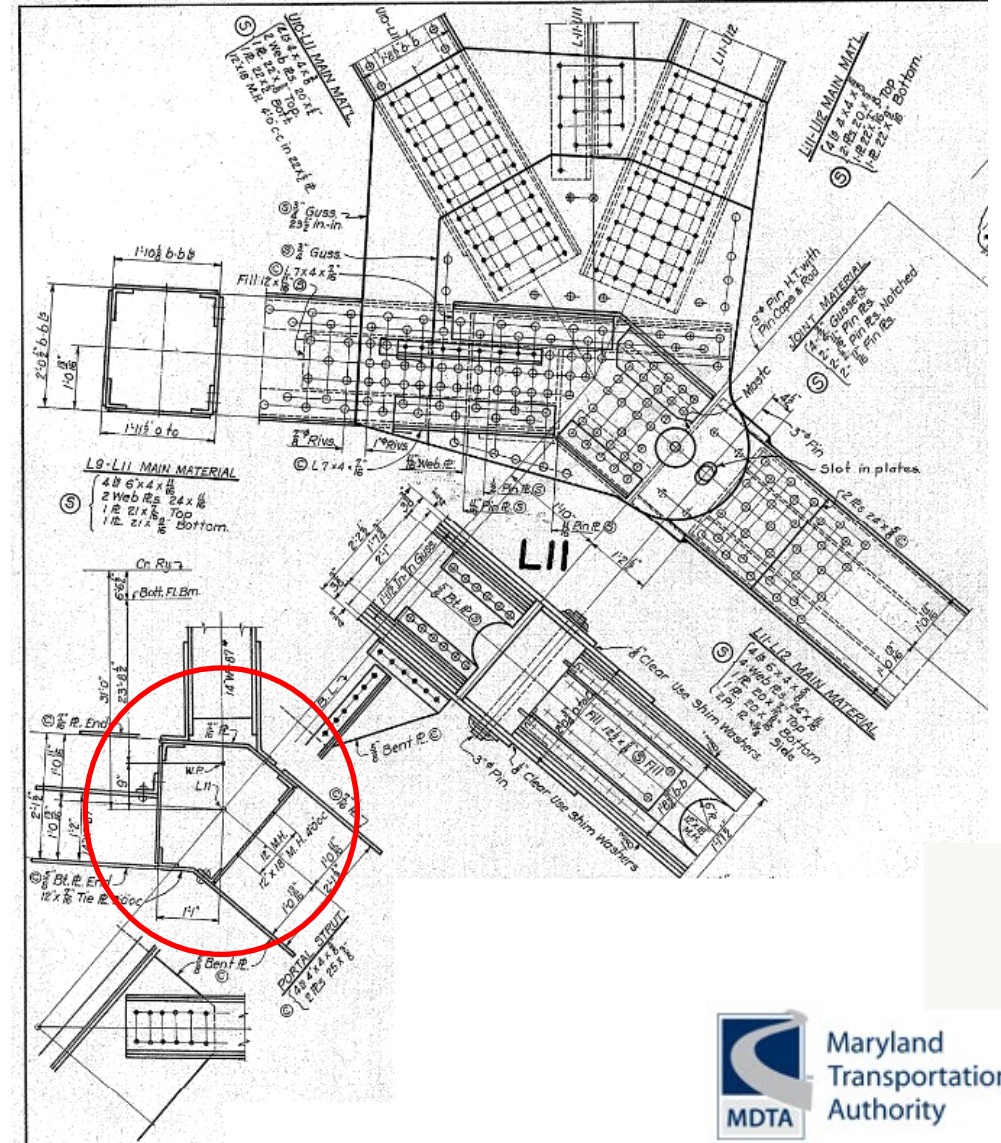
# Problematic Details – Built-Up Members, 20' View



- Connection details are visible
- The number of available plates and shapes was limited
- Maintenance was an apparently as afterthought

# Problematic Details – Built-Up Members, Up Close

- Trusses in multiple planes tied together along irregularly shaped box beam struts
- Openings for fabrication access, not maintenance
- Many areas cannot be accessed for repairs without disassembly
- Large Birds building large nests





# Contract HB-3001 – It's a Cleaning and Painting Contract

## "CLEANING and PAINTING and Miscellaneous Structural Repairs"



**Maryland  
Transportation  
Authority**

THOMAS J. HATEM MEMORIAL BRIDGE  
**CLEANING AND PAINTING  
AND MISCELLANEOUS STRUCTURAL REPAIRS**  
OF US 40 BRIDGE OVER THE SUSQUEHANNA RIVER  
CECIL COUNTY/HARFORD COUNTY  
STRUCTURE NO. : H-Z040001  
**CONTRACT NO.: HB-3001-0000**

**ASHTO DESIGN CRITERIA**  
THIS PROJECT HAS BEEN DESIGNED IN ACCORDANCE WITH THE 2011 EDITION OF ASHTO'S "POLYMER CONCRETE DESIGN OF BRIDGES AND STRUCTURES" AND THE 2012 EDITION OF ASHTO'S "STEEL BRIDGE DESIGN SPECIFICATIONS".

**INDEX OF SHEETS**  
REFERS TO DRAWING HLG-001.

**REFERENCE DRAWINGS**  
THE FOLLOWING REFERENCE DRAWINGS DO NOT REPRESENT WORK TO BE PERFORMED AND RETURN TO THE ORIGINAL SOURCE FOR THE CORRECTING ASSISTANCE AND THE ACCURACY OF THESE DRAWINGS:

DESCRIPTION	DATE
CONSTRUCTION	08/03/2023
DESIGN	08/03/2023
PERMITS	08/03/2023
CONSTRUCTION	08/03/2023
CONSTRUCTION	08/03/2023
CONSTRUCTION	08/03/2023
CONSTRUCTION	08/03/2023

**STANDARDS AND SPECIFICATIONS**  
ALL PROJECTS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE MARYLAND STATE HIGHWAY AND BRIDGE DESIGN SPECIFICATIONS FOR BRIDGES AND STRUCTURES. THE MARYLAND STATE HIGHWAY AND BRIDGE DESIGN SPECIFICATIONS SHALL BE USED AS THE BASIS FOR ALL DESIGN AND CONSTRUCTION. THE MARYLAND STATE HIGHWAY AND BRIDGE DESIGN SPECIFICATIONS SHALL BE USED AS THE BASIS FOR ALL DESIGN AND CONSTRUCTION. THE MARYLAND STATE HIGHWAY AND BRIDGE DESIGN SPECIFICATIONS SHALL BE USED AS THE BASIS FOR ALL DESIGN AND CONSTRUCTION.

**COMPLETENESS OF DOCUMENTS**  
THE MARYLAND TRANSPORTATION AUTHORITY SHALL ONLY BE RESPONSIBLE FOR THE COMPLETENESS OF DOCUMENTS OF RECORD. ALL OTHER DOCUMENTS, INCLUDING BUT NOT LIMITED TO, PERMITS, CONTRACTS, AND AGREEMENTS, SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

**HEIGHT OF WAY**  
THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE HEIGHT OF WAY AND FOR THE PROTECTION OF ALL UTILITIES AND STRUCTURES IN THE AREA OF THE PROJECT.

**UTILITIES**  
THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL UTILITIES AND STRUCTURES IN THE AREA OF THE PROJECT.

**ENVIRONMENTAL INFORMATION**  
THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL UTILITIES AND STRUCTURES IN THE AREA OF THE PROJECT.

**ADVERTISMENT**

MDE No. NA

ADDENDUM	DATE
ADDENDUM 1	08/03/2023

**MARYLAND TRANSPORTATION AUTHORITY**

RECOMMENDED FOR APPROVAL  
*[Signature]*  
08/03/2023

APPROVED  
*[Signature]*  
08/03/2023

CHIEF ENGINEER, OFFICE OF ENGINEERING AND CONSTRUCTION



LOCATION MAP  
SCALE 1"=1/4"



VICINITY MAP  
SCALE 1"=1/4"



**H&H**

PROFESSIONAL CERTIFICATION: I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 44651, EXPIRATION DATE 2024-06-01.



**RJM ENGINEERING**

PROFESSIONAL CERTIFICATION: I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 22851, EXPIRATION DATE 2024-06-01.

- Advertised 08/03/2023
- Opening October 2023
- Comprehensive cleaning and painting of all structural steel
- Includes 277 steel repairs (after Addendums)

# It's a Cleaning and Painting Contract - History

- A programmed comprehensive cleaning and painting contract
- Last comprehensive cleaning and painting (20-year life span) was in the early 1980's approximately 40 years ago
  - HB 2396 included partial C&P to meet immediate maintenance needs and was focused on areas with significant pack rust

# It's a Cleaning and Painting Contract - Progression

Identified as an opportunity to perform pending steel repairs

- Initial consideration only for high priority repairs
- Broadened to consider all steel repairs to take advantage painter's access platforms
- Impacts on cleaning and painting production are minimized and mitigated

# It's a Cleaning and Painting Contract – Production Impacts

## Repairs Designed to be Achievable and Effective

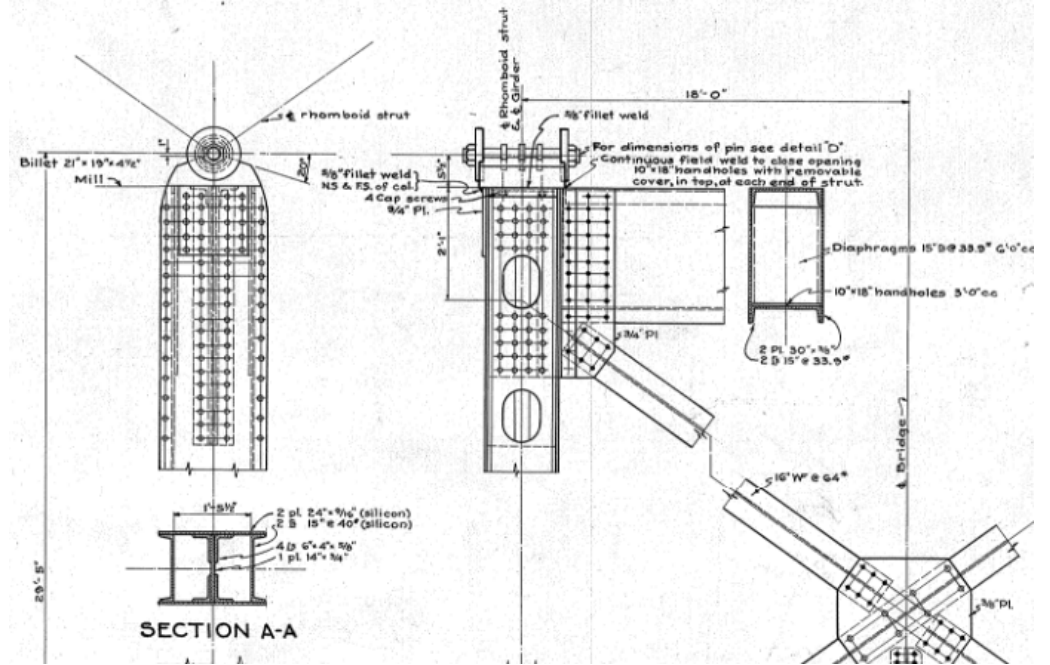
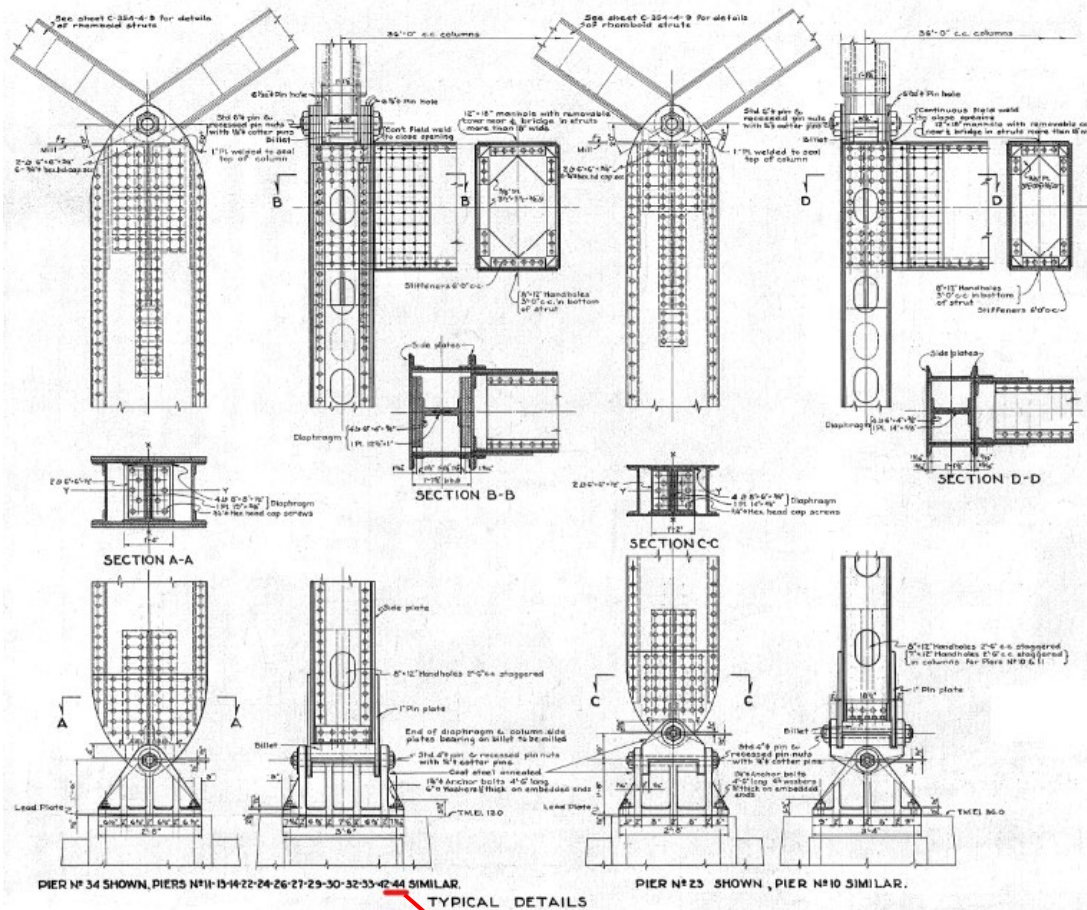
- Temporary bracing, except in one type of repair, was specifically avoided due to impacts on productions
- ‘Good enough’ was prioritized for efficiency and value
- Specialized processes such as jacking of trusses were not considered
- There are a handful of repairs that were tabled but still under consideration

# It's a Cleaning and Painting Contract – Site Issues

Repairs cannot unduly extend total time of contract

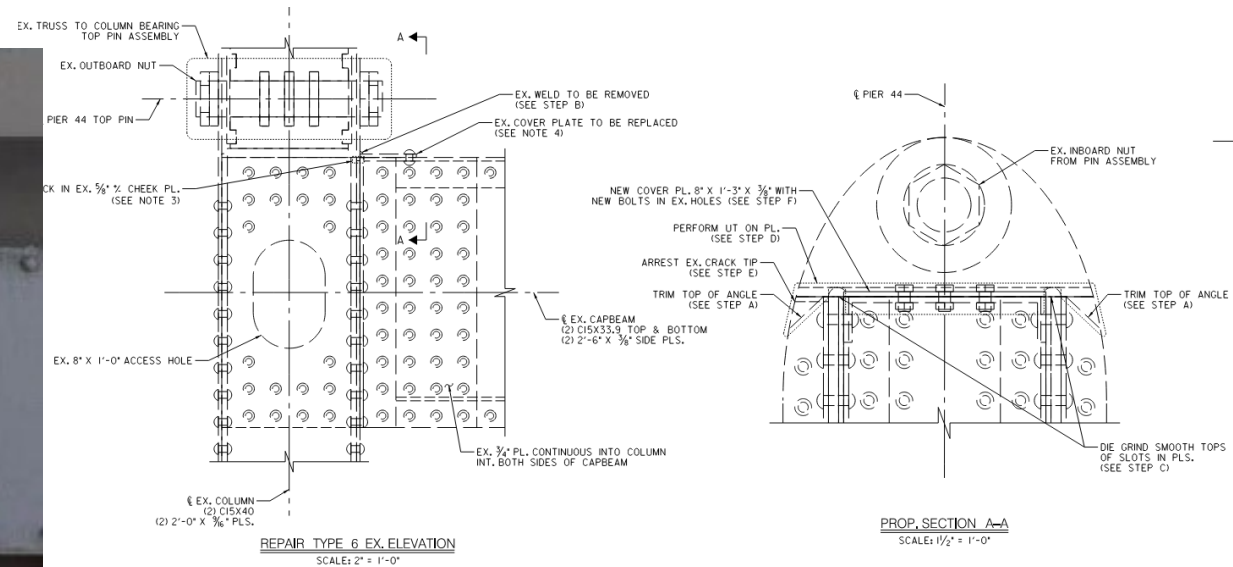
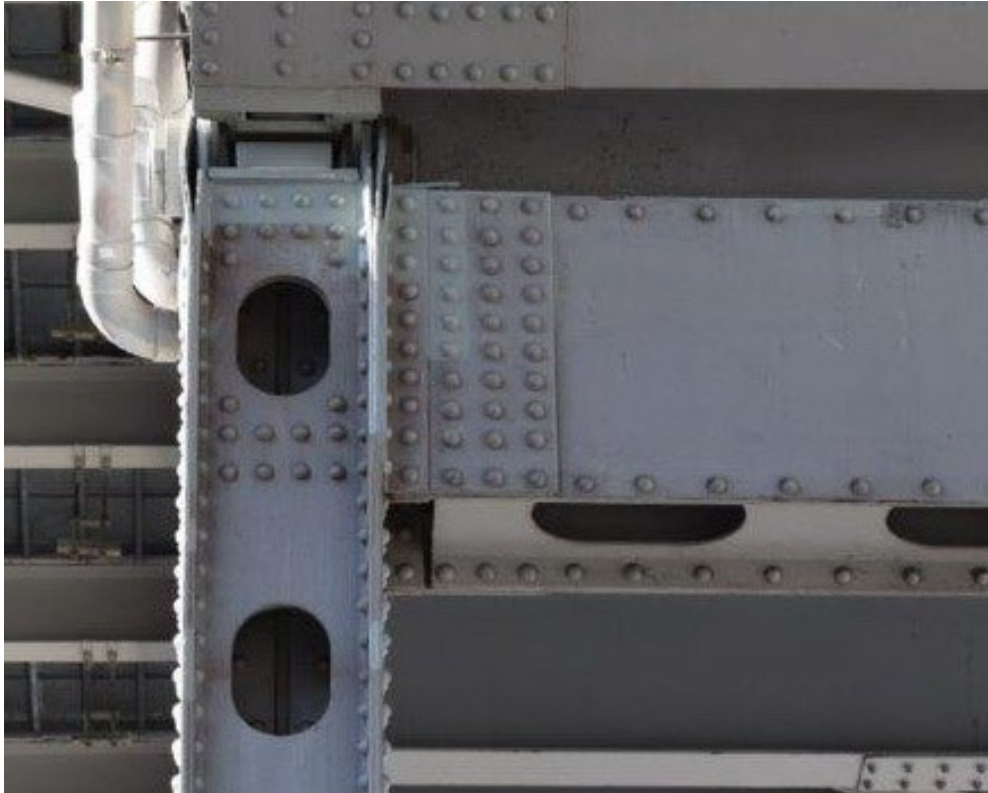
- Access to and from Garrett Island is restricted
  - Staging of equipment, materials, or manpower can not occur from the island
- Roadway access limited to specific time periods
  - Single lane closures during off-peak daytime and extended weekend hours
- Barges cannot tie-off on the substructure
- Railroad rights-of-way impacts at more than one location

# As-Built VS Reality – As-Built (Pier 44 Steel Columns)



Plans show three configurations for tops of steel columns including Pier 44

# As-Built VS Reality – Reality



While columns at Pier 44 are a similar configuration a nearby location, they do not match any of the as-built plans.

# As-Built VS Reality - Previous Projects

Last 30+ Years of an 80+ year old bridge:

- HB 450, Deck Rehabilitation and Miscellaneous Repairs
- TFA 2-1250-20, Susquehanna River Bridge – Rehabilitation, 1987
- HB 2396, Cleaning and Painting at the Hatem Bridge, 2010
- HB-2056, Foundation and Substructure Repairs
- HB 2818, Substructure and Superstructure Rehabilitation of US 40 Bridge over the Susquehanna River, 2015
- HB 2594, Hatem Toll Plaza Pavement Rehabilitation and All Electronic Toll (AET) Conversion

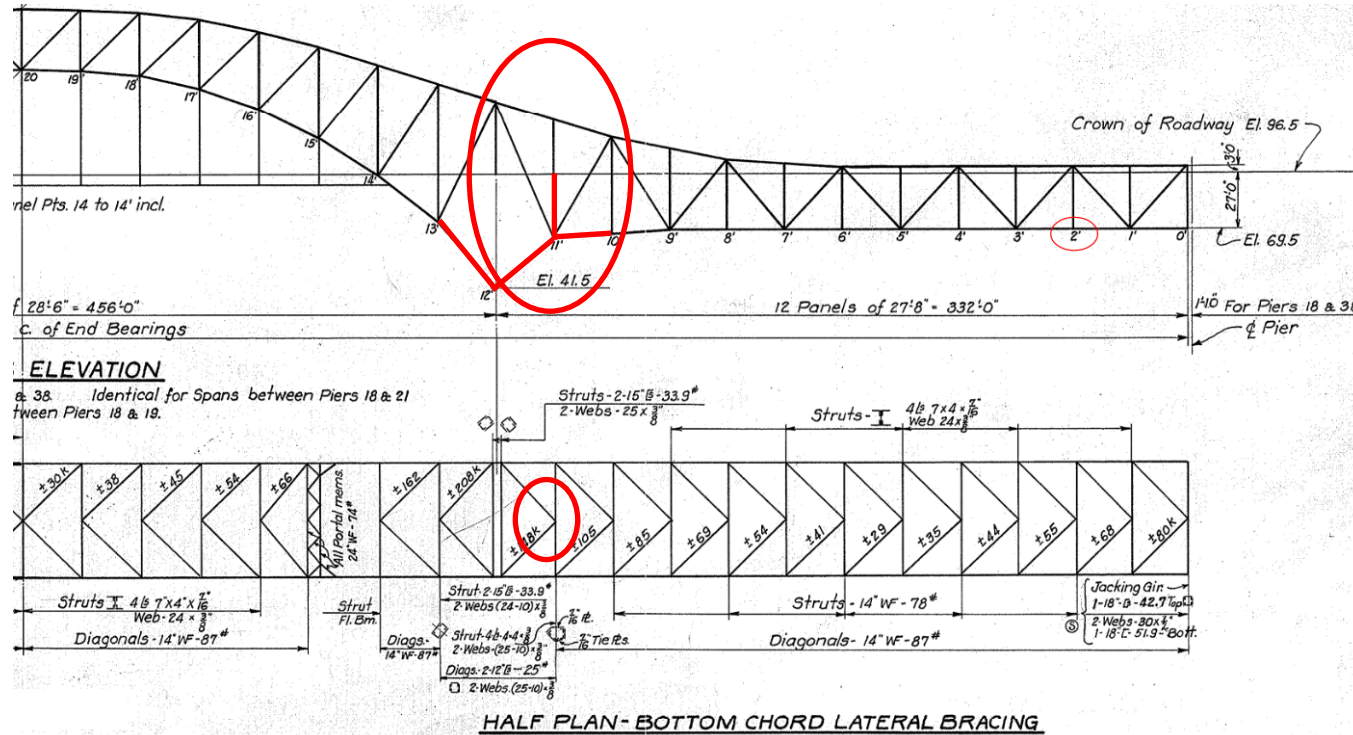


# Secondary Members – In General

Most of the HB-3001 repairs deal with secondary members

- Generally overlooked for repairs in favor of primary load path and defects tend to progress further as a result
- Play critical roles in the overall stability of the bridge
- Many ‘trusses within trusses’ in secondary members
- Combine / convert vertical and lateral forces
- Can be more difficult to access

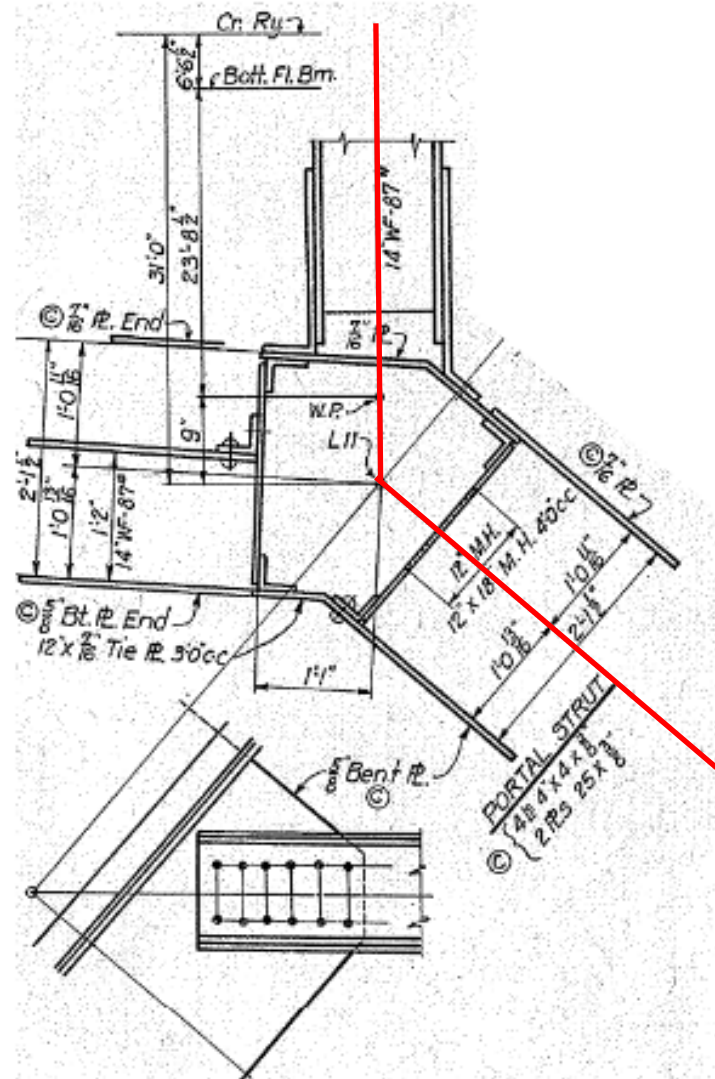
# Secondary Members – Stability



Secondary members with 2 planes converging on a single point, showing 148 kips (+/-) axial loads in bottom laterals

# Secondary Members – Types of Defects

Middle connection point of the bottom strut between L11N & L11S



- Final Sway Bracing before rhomboid over bearings
- Final Lateral Bracing before `bearings

# Secondary Members – Types of Defects (continued)



Exterior



Interior

# Secondary Members – Restraints

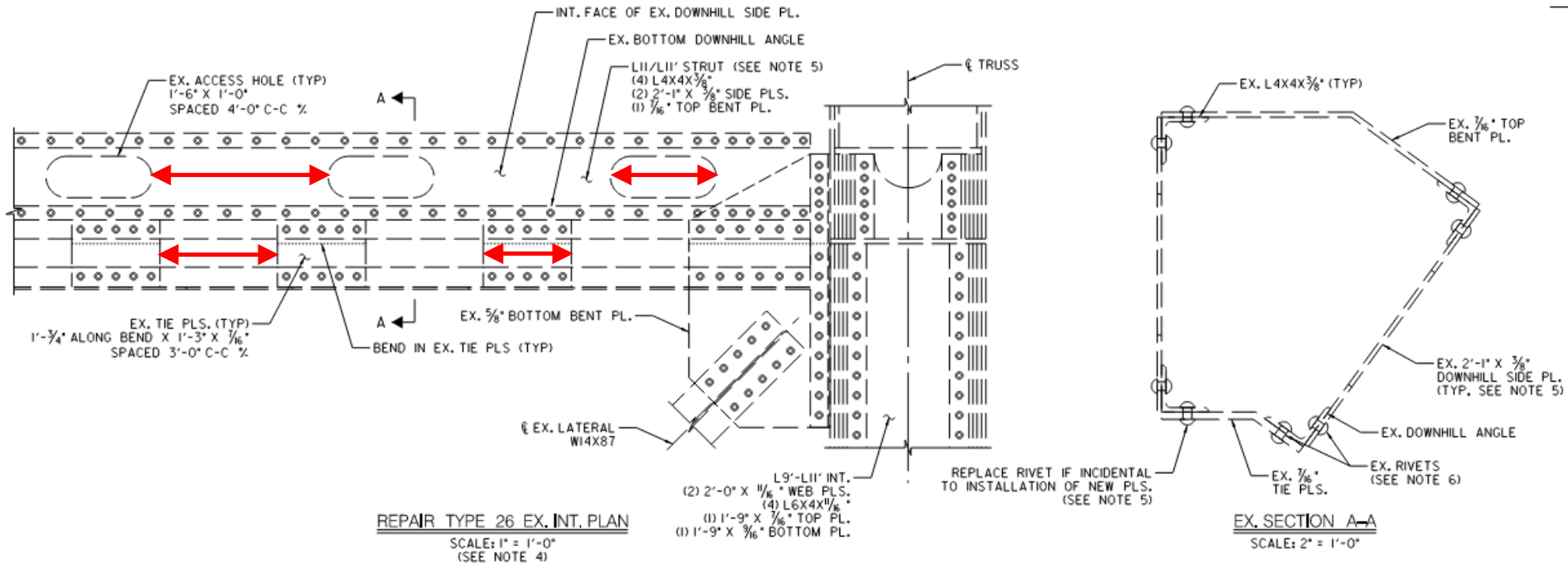


- There is no where to install a temporary strut
- Bracing would take too much time to install and remove given that this is a cleaning and painting contract
- Difficult to justify return on investment

# Design Example 1 – Repair Type 26

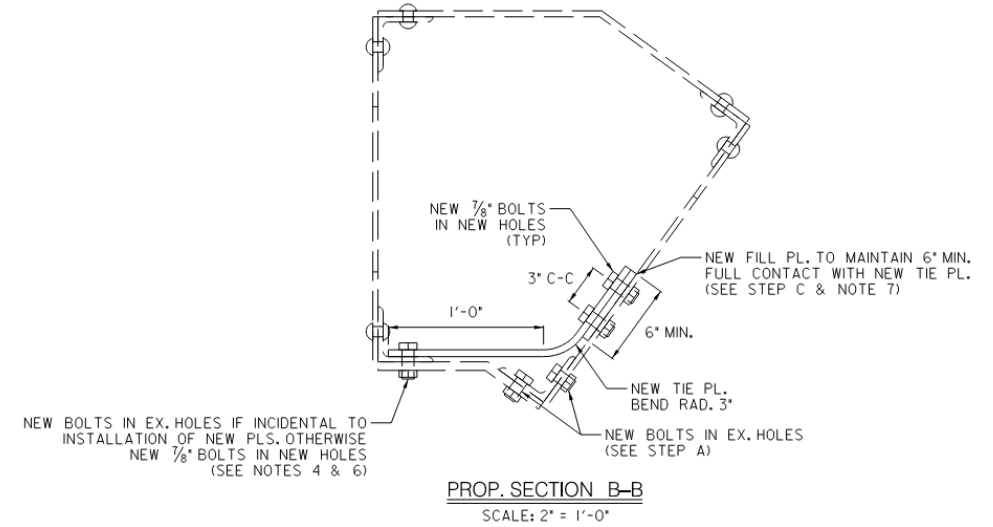
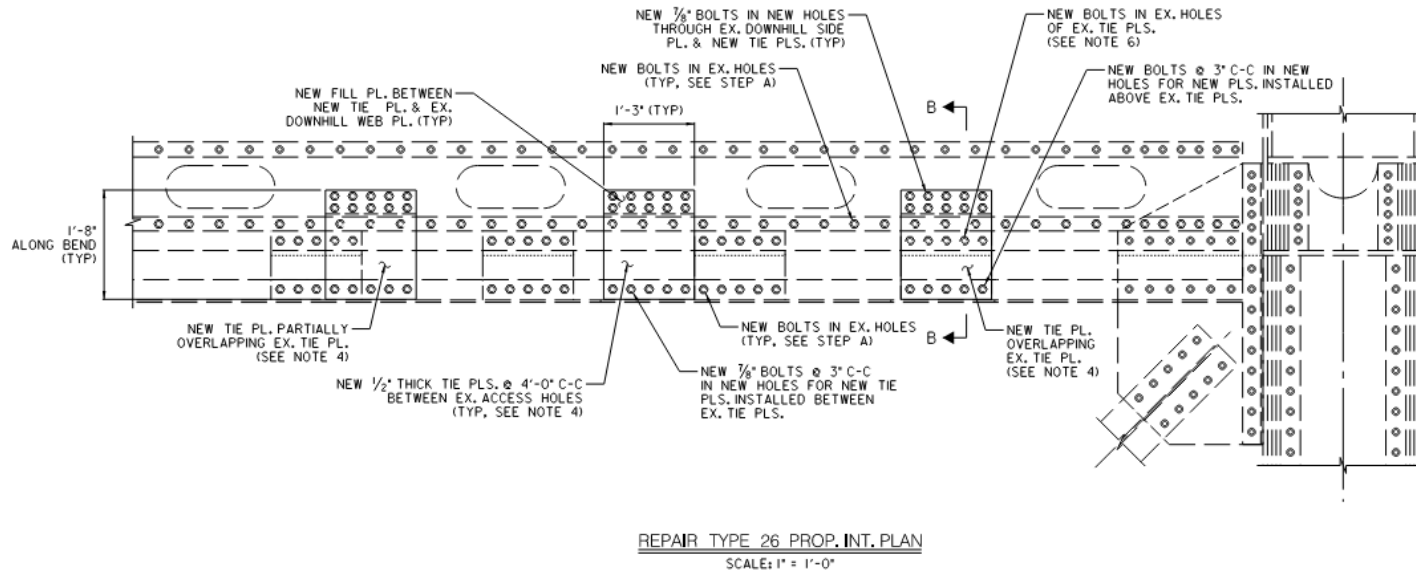
- Repair for the bottom strut corrosion and section loss in the L11N to L11S member previous shown
- No temporary bracing required
- Minimal impact on cleaning and painting production
- Replaces existing fasteners and installs new plates and fasteners to augment existing
- Achievable by non-specialized forces in timely and economical manner

# Repair Type 26 – Existing Plans, Field Verified



Field verified sizes and spacing of bent plates and holes on web plates since as-built drawings did not show details.

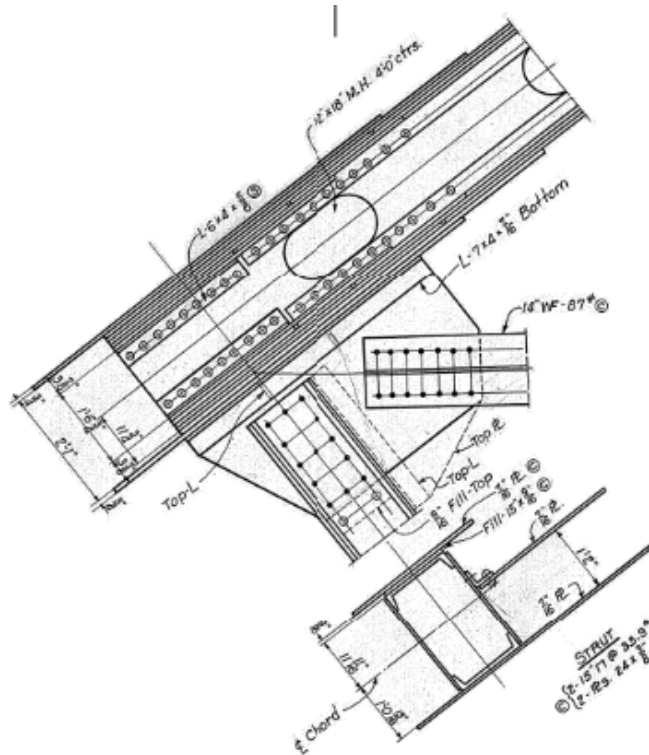
# Repair Type 26 – Proposed Plan



- Replacing existing fasteners between existing web, angle, and tie plates
  - Installing new tie plates that circumvent the angle



# Design Example 2 - Repair Types 23 and 23A



SPAN 37 L13' STRUT AS-BUILT DETAIL  
(L13 SHOWN, L13' SIMILAR)  
SCALE: N.T.S.

- Bottom Strut from L13N to L13S
- On the 'other side' of the bearings from L11N to L11S
- Similar defects, similar challenges, similar philosophy
- Cleaning and painting may expose additional repair needs

# Repair Types 23 and 23A – Existing

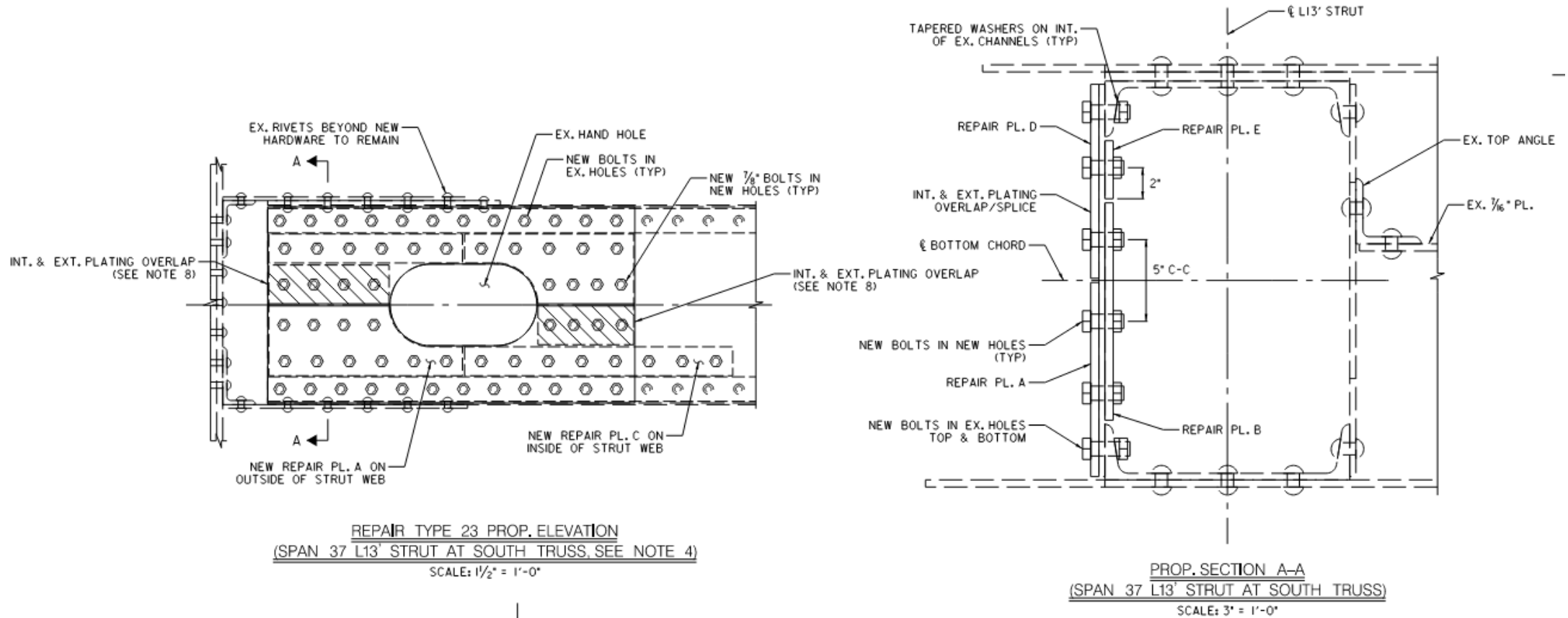


Type 23



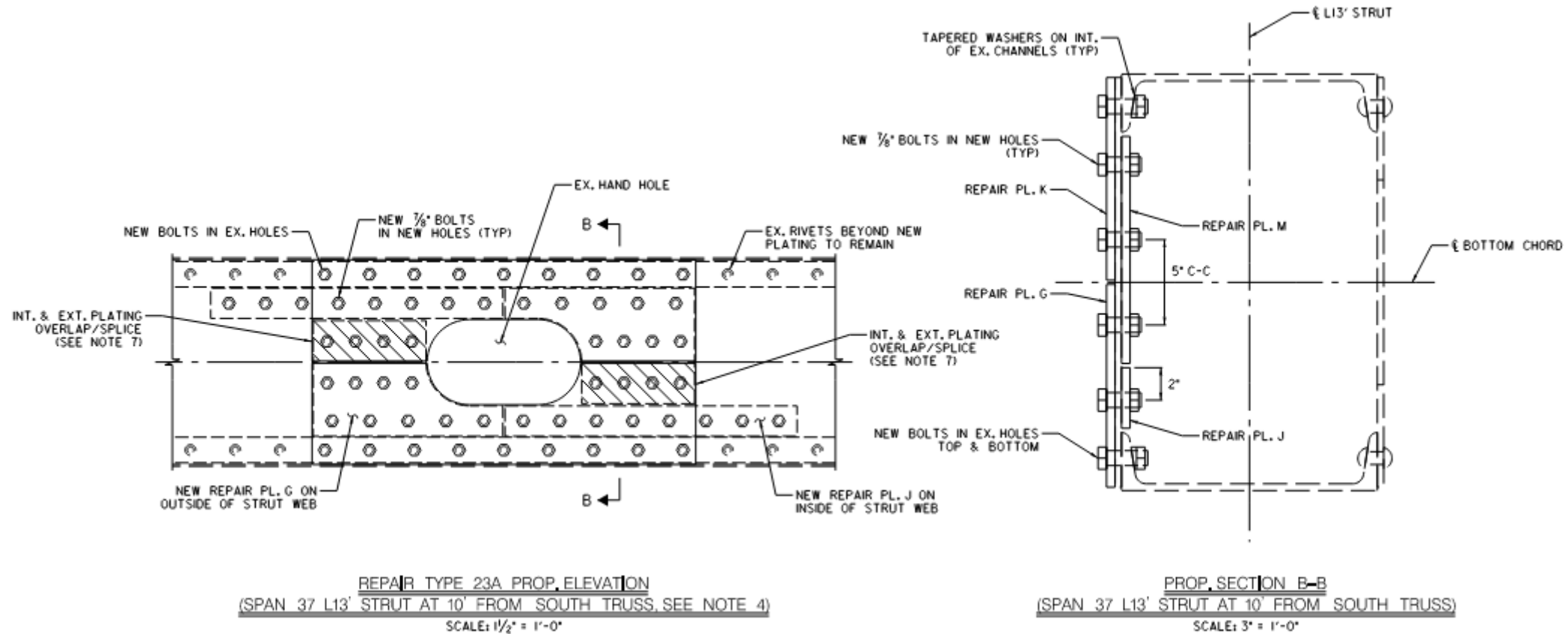
Type 23A

# Repair Type 23 – Proposed Plan



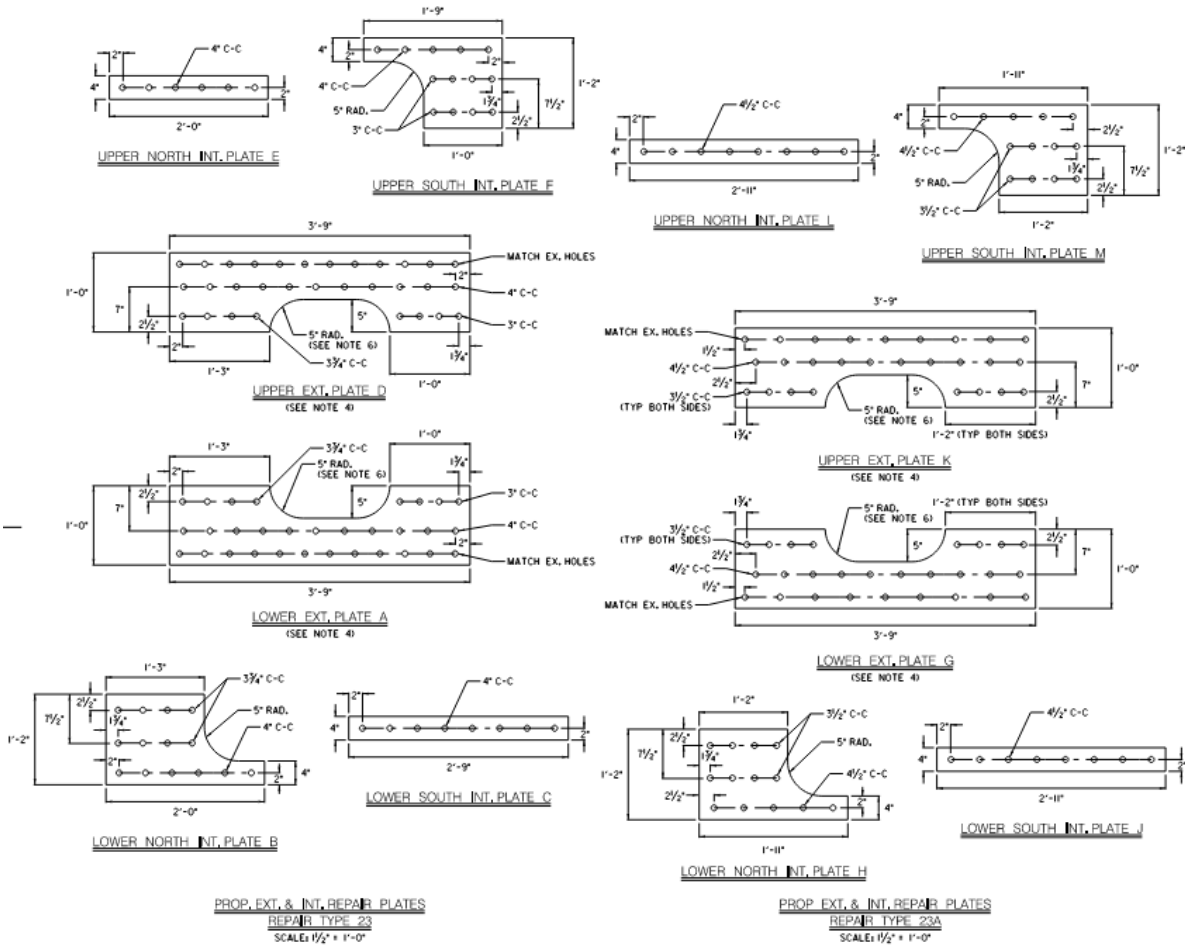
Sequenced fastener removal, plating, and replacement at strut to truss connection

# Repair Type 23A – Proposed Plan



Sequenced Fastener removal, plating, and replacement in the body of the strut

# Repair Types 23 & 23A - Plates

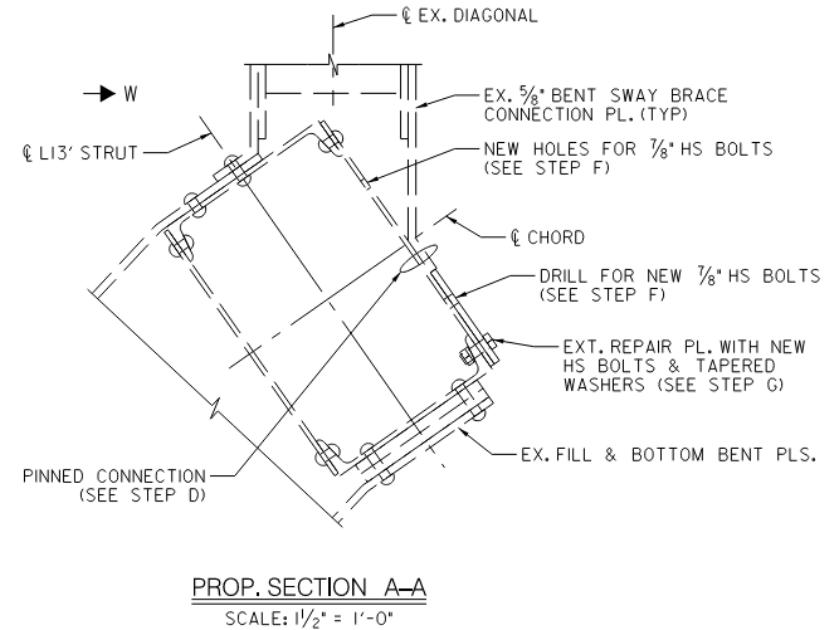
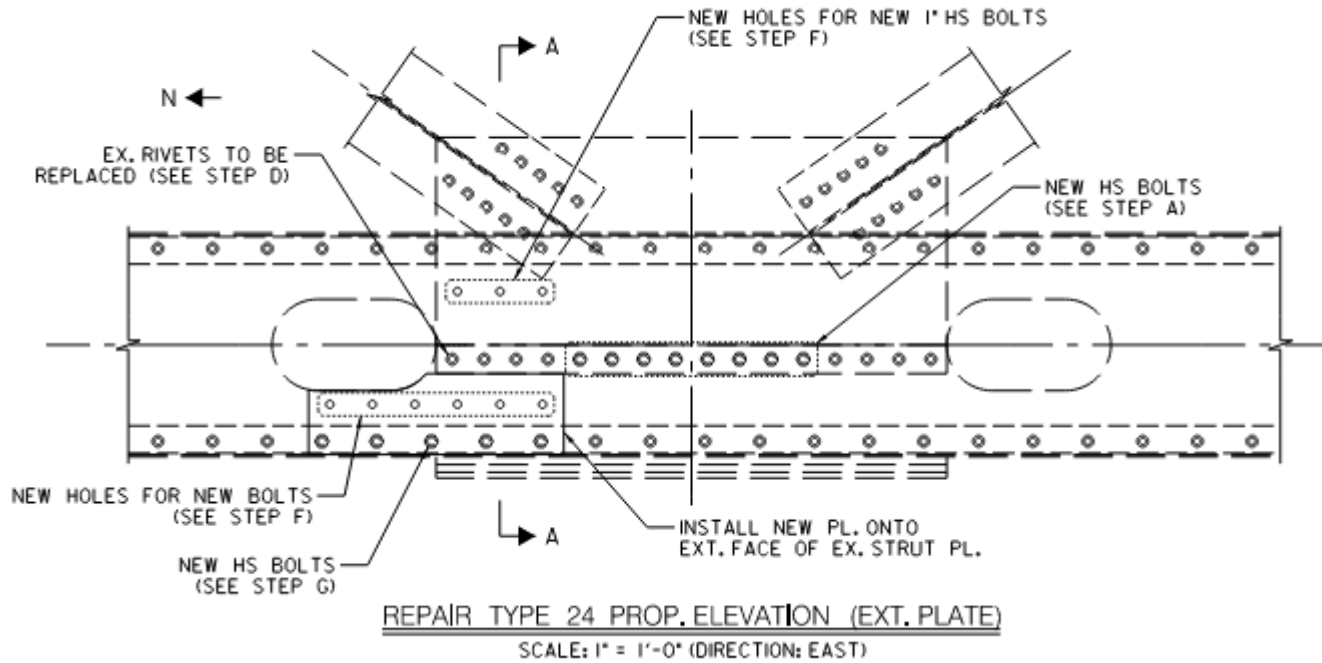


- Sequenced plating replaces existing fasteners and ‘bridges’ areas of severe section loss with new plates
- New plates are fastened through existing plates into new and existing holes
- New interior and exterior plates overlap along seams with extensions included for potential additional plating on adjacent portions.

# Repair Types 24 - Existing

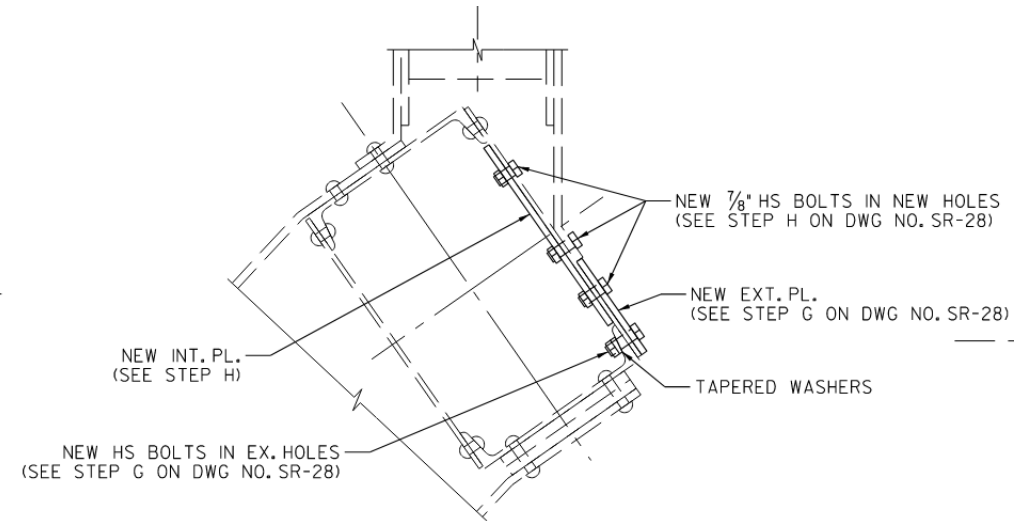
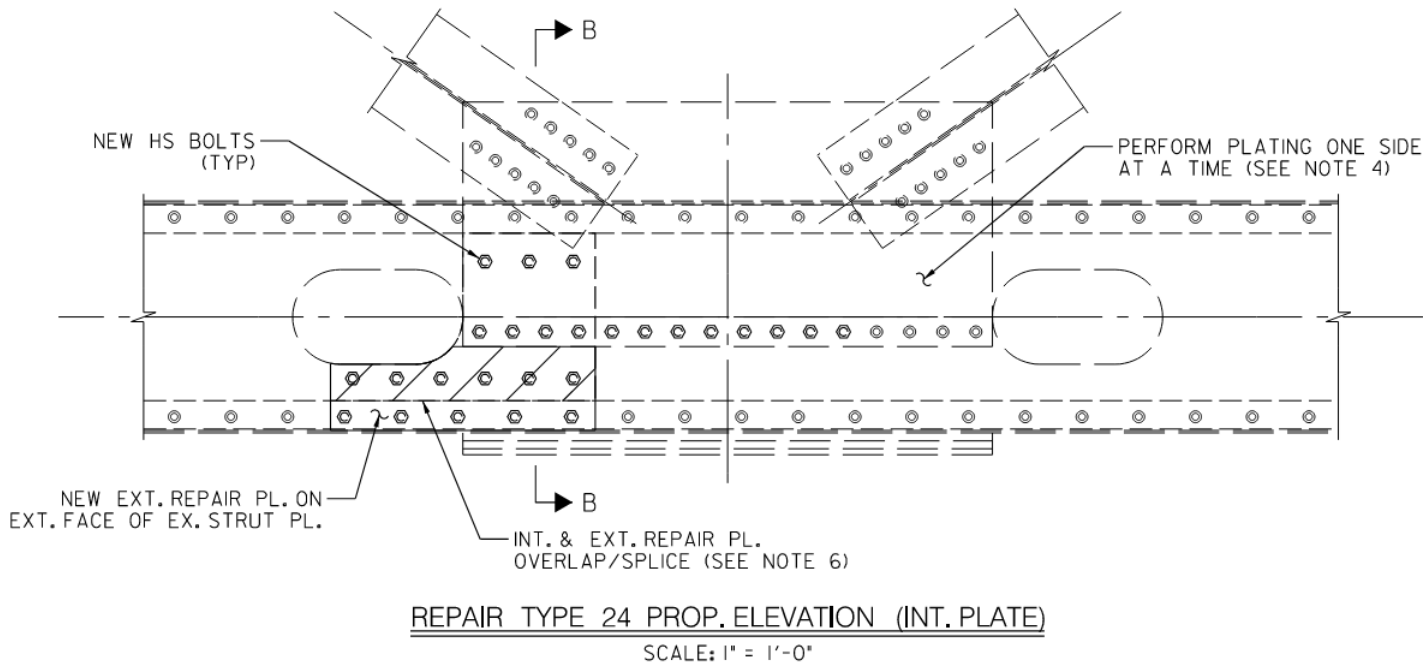


# Repair Type 24 – Proposed Plan, Part 1



- Replacing existing rivets
- Removing previously welded plates
- Predrilling for new plates

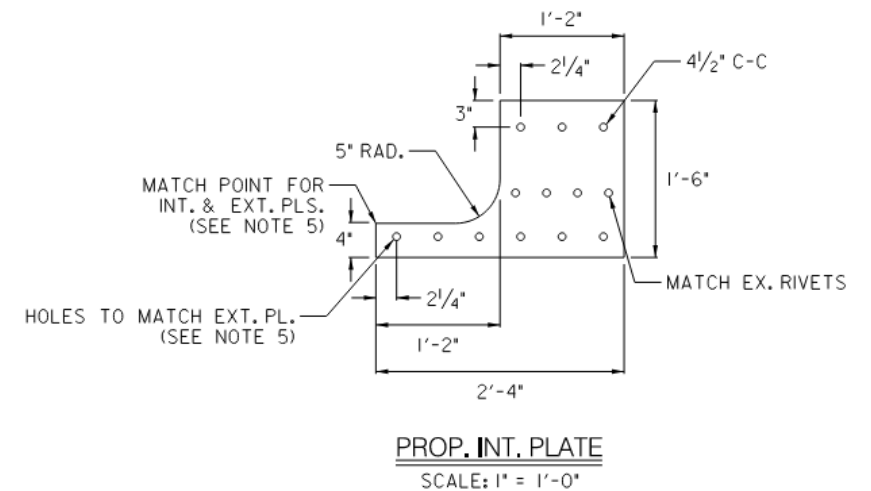
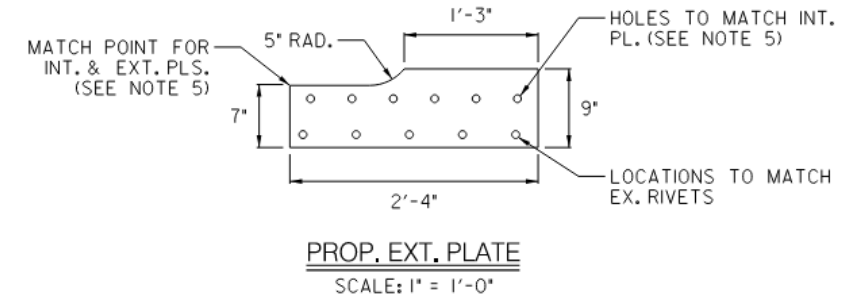
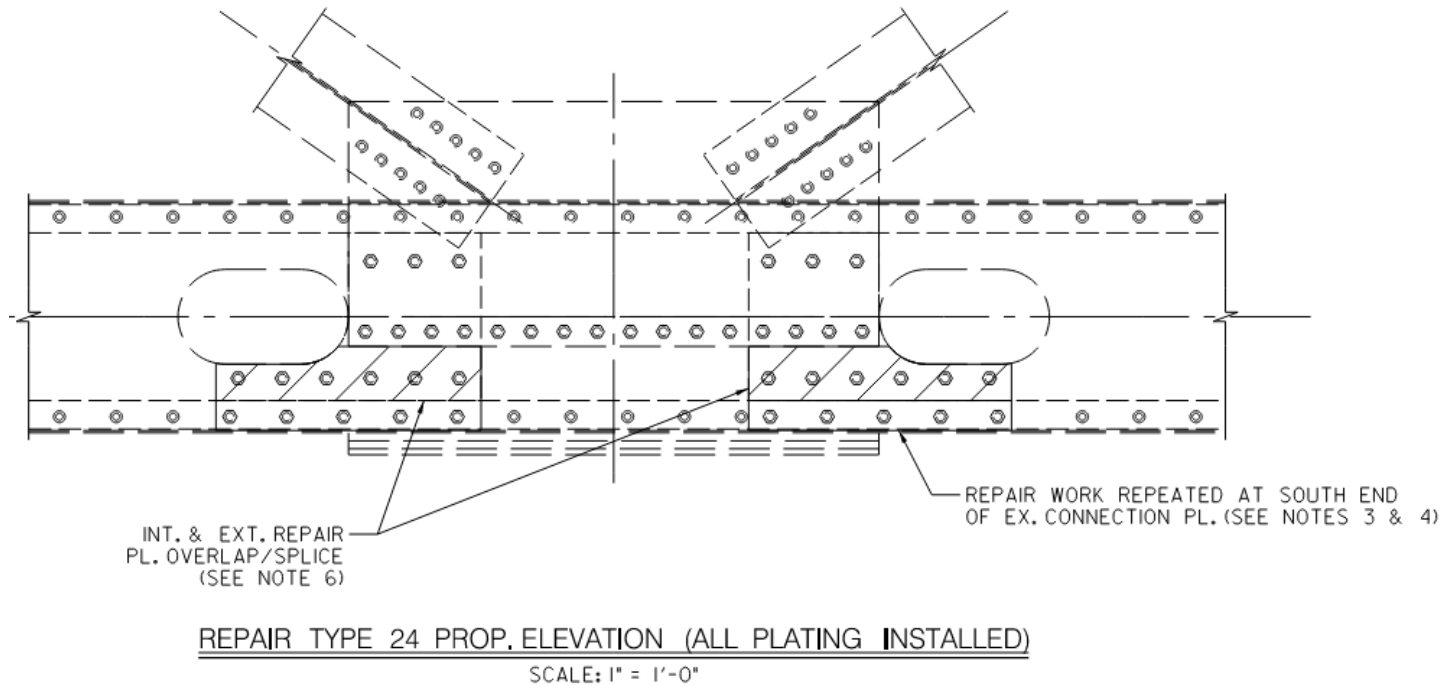
# Repair Type 24 – Proposed Plan, Part 2



- Installing new exterior and interior plates onto existing and new drilled holes
- Repeat for other side of the connection



# Repair Type 24 – Proposed Plan, Complete



- Sway brace connection plate fasteners replaced
- Previously welded repair removed
- Plating areas with severe section loss

# Repairs Revisited

The steel repairs in this contract are designed to:

- Take full advantage of painter's access platforms
- Not impact cleaning and painting production
  - Cleaning and prime coating operations precede all steel repairs
  - Keeping repairs simple and with manageable components
  - Minimizing temporary bracing
- Address high-value repairs in hard-to-reach areas
- Provide flexibility to incorporate additional repairs
- Clean the slate on many otherwise unfeasible repairs

QUESTIONS?

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